Ms./Asmaa Sobhy
Senior Three
Chapter Two
Hormonal Coordination in Living Organisms
Endocrine system

• It is the second system after the nervous system that controls the body functions. So, all the different body functions are under the nervous and hormonal control.

**Endocrine glands:**
They are ductless glands with internal secretions that secrete their hormones directly into the bloodstream with very small amounts to perform their functions.

**Hormones:**
They are organic chemical substances that are synthesized inside the endocrine (ductless) glands and secreted directly into the blood which transports them to another organ where they usually affect the functions and the growth of this organ.

**G.R. Hormones are secreted in small definite amounts**
To perform their functions perfectly
➢ where any increase or decrease in the amount of secretion of any hormone leads to a disturbance in the function of the body organs, resulting in pathological changes and symptoms that are characteristic for each hormone.

➢ Most of the hormones effects are in the form of stimulation, where they stimulate and activate organs or other glands.

**Hormones in plants [Auxins]**

◆ Plants have no special glands to secrete hormones as in animals, but the hormones of the plants (auxins) are secreted by special plant cells.

◆ In 1913, **Boysen Jensen** was considered the first scientist who referred to the auxins (plant hormones) and explained their role in the phototropism of a growing point (stem).

◆ He proved that:
The tip of the stem's coleoptile (receptor site) secretes a chemical Substance **"indole acetic acid"** which is transmitted to the responding site (the site of curvature), causing its bend.
**Auxins:**
They are chemical substances that are secreted from the living cells in the tips of and plant buds (receptor sites) and transmitted to the responding sites, they affect the functions of other parts of the plant.

**Site of secretion:**
G.R. They are secreted from the living cells in the tips of coleoptiles and plant buds. Because the plant has no special glands to secrete auxins.

**Importance:**
The importance of auxins is shown through their effect on the functions of different parts of the plant, where they:
1. Regulate the plant growth.
2. Organize the development of tissues.
3. Regulate the formation of flowers, leaves falling, fruits ripeness and their falling.
4. Affect the functions of all plant cells and tissues.

**Hormones in Animals**

**Discovery of animal hormones**

**1-Cloud Bernar**
- He studied the liver functions in 1855
- He considered the stored sugar inside the liver is its internal secretion and the bile is its external secretion.

**2-Starling**
In 1905:
- He found that the pancreas secretes the pancreatic juice directly, after the arrival of food from the stomach to the duodenum, even after cutting the nerve supply between the pancreas and the other organs.
He concluded that there must be a non-nervous stimulation.

He discovered that the mucous membrane that lines the duodenum secretes certain substances (chemical messages) which pass into the bloodstream, till reaching the pancreas, stimulating it to secrete its pancreatic juice.

He named these chemical messages by "hormones" (a Greek word which means activators)

3-Recent scientific studies

By a succession of the studies and the breadth of the scientific research field, the scientists were able to know the endocrine glands in the human body and the hormones of each gland.

In the following, we will study the hormonal coordination in man, as a model represents the highest evolution.

Hormonal coordination in man

The scientists were able to know the functions of hormones and endocrine glands through:

1. Studying the symptoms that appear on the human or animal, due to the enlargement or the removal of one of the endocrine glands.

2. Studying the chemical structure of the endocrine gland extract and their effects on the different vital activities.

Characteristics of hormones

1. They are organic chemical substances, where some of them are made up of complex proteins and others are made up of simple compounds, such as amino acids or steroids (lipid derivatives)

2. They are secreted in small amounts estimated by micrograms (1/1000 milligram). [1/million of gram]

3. They perform the following important functions:
   1. Keep and regulate the balance of internal environment of the body (Homeostasis)
   2. Body growth.
   4. Metabolism (Utilization of food through anabolism and catabolism processes)
   5. Human behaviour, and his emotional and intellectual development.
Types of glands in human body
There are three types of glands inside the human body, which are:

<table>
<thead>
<tr>
<th>Exocrine glands</th>
<th>Endocrine glands</th>
<th>Mixed glands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glands with external secretions that consist of a secretory part, in addition to a duct or a system of ducts which carries their secretions either to</td>
<td>They are ductless glands with internal secretions that secrete their hormones directly into the bloodstream.</td>
<td>They are glands that gather between the exocrine and endocrine glands, where they consist of a duct glandular part and another ductless glandular part.</td>
</tr>
</tbody>
</table>

A cavity inside the body:
such as the salivary glands and other: digestive glands.
Or
Outside the body:
such as the sweat glands.

Such as:
pituitary gland, thyroid gland and adrenal gland.
Such as:
pancreas – testis – stomach – small intestine

The human body contains a group of endocrine glands which are distributed in different places in the body, and each one of them has its own secretion that contains one hormone or a group of hormones.
**Endocrine glands in man**

- **Pituitary gland**
  - **Adenohypophysis part**
    - Growth hormone (GH).
    - Pituitary tropic hormones
      - Thyroid stimulating hormone (TSH)
      - Adrenocorticotropic hormone (ACTH)
      - Gonadotrophic hormones (FSH & LH)
      - Prolactin
    - Neurohypophysis part
      - Antidiuretic hormone (ADH).
      - Oxytocin hormone
      - (Uterine muscles stimulating hormone)
  - **Thyroid gland**
    - Thyroxine hormone.
    - Calcitonin hormone.
  - **Parathyroid gland**
    - Parathormone hormone.
  - **Adrenal gland**
    - Cortex
      - Glucocorticoids
        - Cortisone hormone.
        - Corticosterone hormone.
      - Mineralocorticoids—Aldosterone hormone.
    - Sex hormones
      - Adrenaline hormone.
      - Noradrenaline hormone.
  - **Pancreas (Islets of Langerhans)**
    - Alpha cells
      - Glucagon hormone.
    - Beta cells
      - Insulin hormone.
  - **Sex glands**
    - (Gonads)
      - Testis
        - Testosterone hormone.
        - Androsterone hormone.
      - Ovary
        - Oestrogen hormone.
        - Progesterone hormone.
  - **Gastrointestinal glands**
    - Stomach
      - Gastrin hormone.
    - Small intestine
      - Secretin hormone.
      - Cholecystokinin hormone.
**First : Pituitary gland**

**G.R.** It is considered the master gland or maestro.
Because it controls the endocrine system through the hormones that are secreted from it and affects the functions and secretions of the most endocrine glands.

**Site:**
It is located beneath the brain and connected with the hypothalamus.

**Note:** The hypothalamus is a link between nervous system and endocrine system.

**Structure:**
Pituitary gland consists of two parts which are: [3Lobes]

1. **Adenohypophysis part:** consists of the *anterior* and *middle lobes*.

2. **Neurohypophysis part:** consists of the *posterior lobe* and a part of the brain called the "infundibulum" (a stalk connects the pituitary gland with the brain.)

### 1-Hormones of the adenohypophysis part

**[Glandular part – Glandular hormones]**

**1-Growth hormone (GH)**

**Its function:**
- It controls the *metabolism* especially the protein synthesis
- So, it controls the *physical growth* of the body.
Diseases of pituitary gland:
The hypersecretion or hyposecretion of this hormone causes a medical case that depends on the age of the patient:

During childhood:
Hypersecretion causes Gigantism. Hyposecretion causes Dwarfism.

In adults:
Hypersecretion causes Acromegaly case [that is characterized by regenerating the growth of long bones at the extremities (such as hands, feet and fingers) and the enlargement of face bones.]

2- Pituitary trophic hormones [Pituitary trophins]
A group of hormones that affect the activity and secretion of some of the other endocrine glands, including:

Thyroid stimulating hormone (TSH), [Thyrotrophins]

Adrenocorticotropic hormone (ACTH): Affects the function of adrenal (suprarenal) gland cortex.

Gonadotrophic hormones:
Affect the functions of gonads (ovaries in females and testes in males), which include the following hormones:

<table>
<thead>
<tr>
<th>Hormone</th>
<th>In female</th>
<th>In male</th>
</tr>
</thead>
<tbody>
<tr>
<td>Follicle stimulating hormone (FSH)</td>
<td>Stimulates the growth of the ovarian follicles and their conversion into Graafian follicle.</td>
<td>Helps in the formation of seminiferous tubules and spermatozoa in testis.</td>
</tr>
<tr>
<td>Luteinizing hormone (LH)</td>
<td>Stimulates the formation of corpus luteum.</td>
<td>Responsible for the formation and secretion of the interstitial cells in testis.</td>
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</tbody>
</table>

⇒ Note: The hormones (FSH) and (LH) are important for the individual sexual maturity.

Prolactin hormone:
It stimulates the milk secretion from the mammary glands.
**Site of their secretion:**
- They are secreted from the nerve cells that are present in the hypothalamus region of brain which are called the "neuro-secretory cells."

**Neuro-secreto cells:**
They are nerve cells that are present in the hypothalamus region of brain and secrete the hormones of neurohypophysis part of the pituitary gland, where these hormones reach the posterior lobe of the pituitary gland.

- These secreted hormones reach the posterior lobe of the pituitary gland through the infundibulum, and they include the following hormones:

1. **Antidiuretic hormone "ADH" (Vasopressin hormone) "VH"**

   **Its function:**
   - It increases the reabsorption of water from the kidney nephrons and decreases the amount of the excreted urine.
   - [Reduces formation of urine]
   - [Dec. in ADH Causes frequent urination(excessive micturition)]

   - It increases the blood pressure.

2. **Oxytocin (Uterine muscles stimulating hormone)**

   **Its function:**
   - There is a direct relation between this hormone and the regulation process of uterine contractions, where it increases them strongly during delivery (labour) process for the baby birth (So, Gynecologists usually use this hormone to accelerate the birth of the baby)

   - It stimulates the release of milk from the mammary glands after the delivery process, as a response to the lactation process (milk letting hormone).
Second : Thyroid gland
(Activity gland)

[Glandular cells that secretes hormones – follicular cells]

**Site:**
- It lies in the anterior part of neck and in a close contact with the trachea.

**Description:**
- It is a vesicular gland whose colour is slightly red.
- It is surrounded by a membrane of connective tissue.
- It consists of two lobes that are connected together by an isthmus.

**Function:**
- It secretes two important hormones for the body, which are:

1. **Thyroxine hormone**
   (iodine element is essential for its formation) that performs many functions in the body, where:
   1. It affects and stimulates the physical and mental growth.
   2. It affects and controls the main metabolic rate.
   3. It stimulates the absorption of carbohydrates (monosaccharides) from the intestine.
   4. It maintains the healthiness of skin and hair.

2. **Calcitonin hormone**
   which works on:
   1. Decreasing the calcium level in the blood.
   2. Preventing the withdrawal of calcium from bones.

**Diseases of the thyroid gland:**
Some medical cases are caused, due to the increase or decrease in the secretion of thyroxine hormone from the thyroid gland, such as "goiter", and there are two types of this disease, which are:

- **Simple goiter**: arises due to the hyposecretion of thyroxine hormone.
- **Exophthalmic goiter**: arises due to the hypersecretion of thyroxine hormone.
A-Hypothyroidism

专家组

Simple goiter:

*Cause:
Hyposcretion of thyroxine hormone, due to the deficiency of iodine in food, water and air.

*Treatment:
Addition of iodine to salt and different foods.

*Complications:
That result from the acute hyposcretion of thyroxine hormone:

A-Cretinism:

*Cause:
The acute hyposcretion of thyroxine hormone during childhood.

*Symptoms:
The acute hyposcretion of thyroxine hormone affects each of the following:
- **Physical growth**: the body is short, head is large and neck is short.
- **Mental growth**: it may cause a permanent mental retardation.
- **Sexual maturity**: it may cause a delay in the sexual maturity.

B-Myxedema:

*Cause:
The acute hyposcretion of thyroxine hormone in adults.

*Symptoms:
- Skin dryness and hair loss.
- Decrease in mental and physical activity
- Weight gain and obesity.
- Decreasing the main metabolic rate that causes cold intolerance.
- Decreasing the heartbeats and rapid fatigability.

*Treatment:
By using thyroid gland hormones or its extracts under the supervision and regular consultation of a specialist.
Exophthalmic goiter:

**Cause:**
The hypersecretion of thyroxine hormone.

**Symptoms:**
- Noticed enlargement of the thyroid gland and anterior part of the neck with protrusion of the two eye balls.
- Increasing the food oxidation and metabolic rate that causes high temperature intolerance.
- Increase in the heartbeats.
- Weight loss.
- Nervous irritability.

**Treatment:** Is either by:
Surgical removal of a part of the thyroid gland.
Or
Using other special medications to suppress the gland.
**Third: Parathyroid gland (Bone gland)**

*Site:*
- They are four small separated lobes, where each two of them are located on each side of the thyroid gland.

*Function:*
- They secrete "Parathormone hormone".

*Function of parathormone hormone:*
1. It plays an important role with calcitonin hormone (secreted from thyroid gland) in preserving the normal calcium level in blood.
2. The amount of parathormone hormone depends on the calcium level in blood, where: its secretion increases, when the calcium level in blood decreases, as it acts on withdrawing the calcium from bones.

**Hyperparathyroidism:**
- [Hypersecretion of parathormone hormone] leads to:
  - Increasing the calcium level in blood, due to the withdrawal (releasing) of calcium from bones which leads to the "bones resorption" and the bones become fragile and liable for bending and fracture easily.

**Hypoparathyroidism:**
- [Hyposecretion of parathormone hormone] leads to:
  - Decreasing the calcium level in blood.
  - Painful convulsions and muscle spasms.
  - Increasing the excitability of nervous system.
**Fourth : Adrenal (Suprarenal) glands**

(Two temper glands)

**Site :**
- They are two glands, where each one of them is located above one of the two kidneys.

**Structure :**
- Each gland consists anatomically and physiologically of two regions, which are:
  - Outer part that is called "cortex".
  - Inner part that is called "medulla"

The hormones that are secreted from the cortex differ from those secreted from the medulla.

**1-Hormones of the cortex**

[Stimulated by ACTH from pituitary gland]

The cortex of the adrenal gland secretes a group of hormones that are known as "steroids" [lipids derivatives] which can be divided into three groups, as follows:

1. **Glucocorticoids:**
   - Include:
     - Cortisone hormone
     - Corticosterone hormone

**Function:**
- Regulate the carbohydrates (sugar - starch) metabolism in the body.
2-Mineralocorticoids:
Include:

**Aldosterone hormone.**

*Function:*
Plays an important role in maintaining the minerals balance in the body, for example: it helps in the **reabsorption of salts**, such as sodium and the **excretion of the excess potassium** through the two kidneys.

3-Sex hormones:
- Although the sex hormones are secreted and produced from the **testes in male** and **ovaries in female**, there are similar hormones that are secreted from the adrenal gland cortex, *such as* → The male sex hormone "testosterone" → The female sex hormones "estrogen and progesterone".

- If there is an **unbalance** between [the secretion of the adrenal gland cortex sex hormones and the sex hormones that are secreted from the special glands], it leads to:
  - Masculinization (Appearance of male characters) in adult females.
  - Feminization (Appearance of female characters) in adult males.
  - Atrophy of gonads in both sexes (in case of the occurrence of a tumor in the cortex of the adrenal gland).

**2-Hormones of the medulla**
- The medulla of the adrenal gland secretes two hormones which are
  - Adrenaline
  - Noradrenaline
- That are known as "emergency hormones". Or "Hormone of rescue"

*Function:*
- They are responsible for many vital activities occurring in the body, when an individual is subjected to emergency situations, such as [fear, fight, excitation and escape] as they:
  1. Increase the sugar (glucose) level in blood that results from the breakdown of glycogen which is stored in the liver into glucose.
  2. Increase the rate and force of heart contraction.
  3. Increase the blood pressure.

- And as a result of all the previous changes,
  1. The muscles take their demands of energy that is needed for their contraction
  2. With increasing the rate of oxygen consumption (this appears clearly during performing exercises).
G.R. It is a mixed gland that gathers between the exocrine and endocrine glands.

Because:

1. It pours its pancreatic juice (digestive enzymes) that are secreted from the pancreatic acini (vesicular cells) through the pancreatic duct into the duodenum, (i.e. it acts as an exocrine gland).

2. It secretes (hormones) directly into the blood from specialized small glandular cells that are called "islets of Langerhans", (i.e. It acts as an endocrine gland).

The types of cells in islets of Langerhans:-
It is possible to differentiate between the two types of cells in islets of Langerhans, which are:

- Alpha cells:-
  - They are small in number
  - They secrete "Glucagon hormone".

*Function of glucagon hormone:
It increases the sugar (glucose) level in blood by increasing the breakdown of glycogen that is stored in liver only into glucose.

\[
\text{Glycogen} \xrightarrow{\text{Glucagon hormone}} \text{Glucose}
\]
**Beta cells:**
- They represent the majority of islets of Langerhans cells
- They secrete "Insulin hormone".

**Function of insulin hormone:**
It decreases the glucose level in blood through:
- Stimulating the transport of all monosaccharides (except fructose) through the cell membrane to inside the cell and stimulates the oxidation and utilization of glucose in the different body tissues and cells.
- Note:- Fructose sugar passed into the cells without needing to insulin hormone
- Controlling the relation between the glycogen that is stored in liver and the glucose that is free in blood, where it stimulates the conversion of glucose into:
  - Glycogen that is stored in the liver and muscles.
  Or
  - Lipids that are stored in the different body tissues. [under skin]

**Hyosecretion of insulin hormone:**
**Diabetes Mellitus**
Leads to the occurrence of a disturbance in the metabolism of carbohydrates (glucose) and lipids in the body, causing "Diabetes Mellitus" disease.

**Symptoms of Diabetes Mellitus disease:**
- The increase of glucose level in blood above the normal level (appears in the blood analysis)
- Continuous thirst sensation and excessive micturition, as a result of the presence of glucose in urine (appears in the urine analysis) that is associated with the excretion of large amounts of water.
- Diabetic patients are sometimes exposed to coma.
- Note:-
  - Glucagon hormone antagonizes the action of insulin hormone.
  - Glucagon hormone and insulin hormone have a direct relation with the utilization of glucose in the body, therefore they preserve the glucose level constant in blood which between (80 — 120 milligram/100 cm).

Diabetic patients are injected by insulin instead of having it through mouth, because the insulin hormone consists of protein, if it is taken through mouth, it will be digested by the protein digestive enzymes in stomach and intestines before reaching the blood circulation.
Glucose uptake ↑

Blood glucose ↓ to normal levels

Normal blood glucose levels: 4 – 6 mM

Blood glucose ↑

Blood glucose ↑ to normal levels

Glycogenolysis ↑
Gluconeogenesis ↑

Glycogenesis ↑
Gluconeogenesis ↓

Glucagon

Low Blood Glucose

High Blood Glucose

Pancreas

Glucagon Released by Alpha Cells of Pancreas

Insulin Released by Beta Cells of Pancreas

Liver Releases Glucose into Blood

Fat Cells Take in Glucose from Blood

Achieve Normal Blood Glucose Levels
The sex glands (gonads) in human include:
- Testis in male.
- Ovary in female.

**Their function:**
1. The formation of male gametes (sperms) and female gametes (ova). *Main function*
2. The secretion of a group of sex hormones that are responsible for the growth of the genital organs and the appearance of secondary sex characters.

They are divided into two types, which are:

**1-Male sex hormones**
Male sex hormones are called *Androgens* and include two hormones, which are:
1. Testosterone hormone.
2. Androsterone hormone.

**Site of secretion:**
Secreted from the interstitial cells in testis.

**Function:**
- The growth of prostate gland and two seminal vesicles.
- The appearance of male secondary sex characters.

**2-Female sex hormones**
Some female sex hormones are called *estrogens* and include two hormones, which are:

<table>
<thead>
<tr>
<th>Site of secretion</th>
<th>Function</th>
</tr>
</thead>
</table>
| Estradiol (Estradiol) | Secreted from the Graafian follicles in the ovary. | Helps in the appearance of female secondary sex characters, such as:
- The increase in breast's size
- The regulation of menstrual cycle. |
| Progesterone | Secreted from the corpus luteum in the ovary and placenta in the uterus. | It regulates the breeding cycle, as:
- It regulates the vascularity of the uterine wall and prepares the uterus to receive the embryo (fertilized ovum).
- It regulates the changes taking place in the mammary glands during pregnancy. |
Relaxin hormone: secreted from the corpus luteum in the ovary, placenta and endometrium. Its secretion increases at the end of the pregnancy period, causing -The relaxation of pubic symphysis to facilitate the delivery process.

Seventh: Gastrointestinal Hormones

➢ The mucous membrane lining the alimentary canal:
  - Contains a group of glands that secrete the digestive juice.
  - Secretes a group of hormones that stimulates the glands of the alimentary canal to secrete the digestive enzymes and their different juices, such as:

Gastrin hormone

*Site of secretion:
It is secreted from the mucous membrane lining the stomach

*Function:
It is transferred through the blood to stomach again, stimulating it to secrete its "gastric juice".

Secretin and Cholecystokinin hormones

*Site of secretion:
They are secreted from the mucous membrane lining the small intestine

*Function:
Hey are transferred through the blood to pancreas, stimulating it to secrete its "pancreatic juice".
Hormones that preserve the internal balance of the body:

1. Calcitonin
   - Regulate the calcium level in the blood.

2. Parathormone

3. Insulin
   - Regulate the glucose level in the blood.

4. Glucagon

5. Antidiuretic hormone (ADH)
   - Decreases the amount of urine excreted by the reabsorption of water from the kidney nephrons.

6. Aldosterone
   - Plays an important role in preserving the mineral balance in the body such as the regulation of sodium and potassium ions in the blood.

Hormones of metabolism:

1. Growth hormone
   - Controls the metabolism, especially the protein synthesis.

2. Thyroxine
   - Controls the main metabolic rate.

3. Cortisone
   - Regulate the carbohydrate (starch and sugar) metabolism in the body.

4. Corticosterone
   - Stimulates the glucose oxidation and utilization inside the different body tissues and cells.
   - Converts the glucose into glycogen or lipids that are stored in the liver and muscles or in other body tissues.

5. Insulin
Hormones that affect on the mammary glands:

1. Oestrogen
   - Increases the breasts in size.

2. Progesterone
   - Regulates the changes that take place in the mammary glands during pregnancy.

3. Oxytocin
   - Stimulates the release of milk from the mammary glands as a response to the lactation process.

4. Prolactin
   - Stimulates the milk formation and secretion from the mammary glands.

Hormones of the sexual maturity in male human:

1. FSH
   - The formation of seminiferous tubules in testis.
   - The formation of sperms (spermatogenesis) in testis.

2. LH
   - The formation of interstitial cells in testis.
   - The stimulation of interstitial cells to secrete the male hormones.

3. Testosterone
   - The growth of prostate gland and two seminal vesicles.

4. Androsterone
   - The appearance of male secondary sex characters at puberty.

Hormones of the sexual maturity in female human:

1. FSH
   - Affects the growth (maturation) of the ovarian follicles in the ovary and converting them into Graafian follicle (in ovum maturation (proliferation) stage).

2. LH
   - Causes the rupture of Graafian follicle, the release of ovum and the formation of corpus luteum from the remains of Graafian follicle (in ovulation stage).

3. Estrogen (Estradiol)
   - The appearance of female secondary sex characters at puberty, such as the growth of the mammary glands and the regulation of menstruation (menstrual cycle).
<table>
<thead>
<tr>
<th>Medical condition</th>
<th>Causes</th>
<th>Symptoms</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Gigantism</td>
<td>Hypersecretion of growth hormone during childhood.</td>
<td>A significant increase in the length than the normal range.</td>
<td>—</td>
</tr>
<tr>
<td>2. Dwarfism</td>
<td>Hyposcretion of growth hormone during childhood.</td>
<td>A significant decrease in the length than the normal range.</td>
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<tr>
<td>3. Acromegaly</td>
<td>Hypersecretion of growth hormone in adults.</td>
<td>Increase of bone growth at the extremities (such as hands, feet and fingers) and an enlargement of face bones.</td>
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<tr>
<td>4. Simple goiter</td>
<td>Hyposcretion of thyroxine hormone, due to the iodine deficiency in food, water and air.</td>
<td>Simple enlargement of the thyroid gland.</td>
<td>Addition of iodine to the salt and different food.</td>
</tr>
<tr>
<td>5. Cretinism</td>
<td>Acute hyposcretion of thyroxine hormone during childhood.</td>
<td>* Short stature, large head and short neck.</td>
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<td>* May cause a permanent mental retardation.</td>
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<td>* May cause a delay in the sexual maturity.</td>
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<td>* Weight gain and obesity.</td>
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<td>* Decreasing in the main metabolic rate which causes cold intolerance.</td>
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<td></td>
<td>* Decreasing the heartbeats and rapid fatigability.</td>
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<tr>
<td>7. Exophthalmic goiter</td>
<td>Hypersecretion of thyroxine hormone.</td>
<td>* Noticed enlargement of the thyroid gland and anterior part of the neck with protrusion of the eye balls.</td>
<td>* Surgical removal of a part of the thyroid gland.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>* An increase in the food oxidation and metabolic rate.</td>
<td>* Using other special medications.</td>
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<td>* Loss of weight.</td>
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<td>* An increase in heartbeats.</td>
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<td>* Nervous irritability.</td>
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<tr>
<td>8. Diabetes Mellitus</td>
<td>Hyposcretion of insulin hormone.</td>
<td>* A disturbance in the metabolism of glucose and lipids which leads to:</td>
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<tr>
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<td></td>
<td>- The increase of the glucose level in blood, which may lead to a diabetic coma.</td>
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<td></td>
<td>- Continuous thirst sensation and excessive micturition, due to the increase of sugar level in urine that is accompanied with the excretion of large amount of water.</td>
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